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COUNTRY	Hungary	REPORT NO.	[redacted] 25X1
SUBJECT	Comments on the New (1951) Procedure for Calculating Construction Safety in Hungary	DATE DISTR.	August [illegible]
		NO. OF PAGES	1
DATE OF INFO.	[redacted]	REQUIREMENT NO.	RD 25X1
PLACE ACQUIRED		REFERENCES	
DATE ACQUIRED			

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Approved For Release 2008/01/16 : CIA-RDP83-00418R005400590001-6

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COUNTRY: Hungary

SUBJECT: Comments Concerning the New (1951) Procedure for Calculating Construction Safety in Hungary

NO. PAGES: 3

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1. [redacted] the safety factor in engineering construction is of great importance since it involves human life, but exaggerated safety controls are both unreasonable and uneconomical. Constructions must be safe and economical to be of merit; therefore, engineers are faced with the problem of developing equipment to meet these two prime requirements. 25X1

2. Generally, a construction is considered safe if it can sustain twice the load for which it had been constructed. This applies to all constructions with the exception of machines -- particularly their rotating parts -- where a safety factor up to 10 is required. Following is an example in which a steel railroad bridge is used to illustrate the calculation of construction safety in Hungary prior to 1951: If it is known that a bridge was designed under provision of a double safety factor, one assumes that the bridge is able to carry twice the weight of the permissable live load. In reality, however, this premise is incorrect since the bridge would not actually collapse until the load reached about 2.3 times the weight of the permissable load. That the premise is incorrect is due to the inaccurate calculating system used. In this system the double safety factor for the total amount of both the live load and dead load was used for the calculation but, actually, it is only the live load which increases while the dead load remains the same. Thus, in calculating safety which involves the total live load and dead load, heavy constructions actually have a greater margin of safety than do light constructions. Developing this idea further, it is apparent that the actual margin of safety of the various parts of a construction such as the main beam, cross beam, etc., is not the same but varies according to the dead load of the part. An increased margin of safety for certain parts of a construction has no practical effect, however, because the over-all safety of the entire construction depends on the safety of the parts which have the lowest dead load.

3. [redacted] the following method which was introduced in Hungary in 1951 is more exact from a technical point of view: In order to ascertain the total load, the forces caused by the live load are multiplied by the safety and dynamic factors; then the value of the forces caused by the dead load is added to this amount. In this calculation, the dead load is provided with a certain safety provision; however, in order to arrive at the certain safety provision for the construction against the forces caused by the dead load, it is not necessary to multiply the dead load with the same safety factor used for the safety provision of the live load. Conversely, safety is provided against the forces caused by the dead load when the theoretical weight of the structure is increased or decreased by ten percent. Ten percent is added to the weight of the structure if the live load causes the same type of charge (tension or compression) in the structure as the dead load; ten percent is subtracted if the live load produces the opposite type of charge as the dead load. When the live load causes a variable type of charge in a particular part of the construction (sometimes tension, sometimes compression; i.e., in the grids of a trussed beam) the theoretical weight of the part is decreased or increased by ten percent so that the particular part can meet the type of charge which causes greater forces. 25X1

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4. Following is the mathematical expression of the new method introduced in Hungary in 1951 and described in para. 3, above:

$$Y_L = v.Y_d + n_1.n_2.Y_l$$

$$n_1.m_2.Y_l = Y_L - v.Y_d$$

$$n_1 = \frac{Y_L - v.Y_d}{n_2.Y_l}$$

Y_L is the "limit charge" - the total value of the dead load and live load under provision of a given safety and dynamic effect.

v is the multiplying factor for the dead load. (o.9 or 1.1)

n_1 is the given live load safety factor

n_2 is the given dynamic factor

Y_l is the charge caused by the live load

Y_d is the charge caused by the dead load.

5. If the old (prior to 1951) method of calculation -- which is now obsolete in Hungary -- were applied, the stresses caused in different parts of the structure would be checked instead of the safety of the different parts. The safety factor was ostensibly determined by the value of the working stress which, in turn, was a certain proportion of the ultimate strength. In practice, however, there was no way to measure the stress of the construction; the stretch of the material subjected to load was measured instead of the stress. Therefore, it is more logical to give the capacity of a construction in value of permitted forces caused by the load rather than in stresses; i.e., to give the capacity in kilograms or tons instead of in kg/cm^2. since it is easier to measure the force. For a practical application of this theory, it was necessary to introduce a new idea -- the so-called "limit stress". The limit stress is the greatest stress to which material could be subjected without damaging deformation of the material. This new method, introduced in 1951, omitted all calculations involving working stress.

6. In the new method of calculation the value of the limit stress for plate girder beams made from 36/24/12A steel (36 $kg./mm^2$ represents the ultimate strength; 24 kg/mm^2 is the proportional limit, and 12A is the designation number - - this is one of the standard types of Hungarian steel) is S_L = 1,950 kg/cm^2. (S_L, the American equivalent for that which the Hungarians express as $\mathcal{S}L$, represents the limit stress.) The value of the limit stress for trussed constructions made from the same type of steel is S_L = 1,850 kg/cm^2. The working stress in both types of constructions made from the above-mentioned steel is 1,400 kg/cm^2. The limit shearing stresses in rivets: $S_\delta = 0.7.S_L$. The bearing stress on rivets: $S_b = 2.0.S_L$. The limit capacity of a particular part of a construction is determined by multiplying the cross section of the part by the limit stress. In compressed constructions, the limit stress is referred to as limit buckling stress.

7. In order to determine whether or not a particular part of a construction has sufficient strength to carry the maximum load under a given safety provision, the limit charge of the part is compared with the limit capacity of the part. The part is sufficiently strong if the value of its

limit charge is lower than the value of its limit capacity. The basic formula of the new method is that only the forces caused by the live load are multiplied by the safety factor and the safety factor of the part is determined rather than the stresses caused in the part. The safety factor varies for various types of constructions and corresponds with the regulations issued for a particular type of construction. The safety factor for railroad bridges was 1.4; for highway bridges, as well as various other civil engineering constructions, the safety factor was 1.5. The value of the dynamic factor varies from 1.4 to 1.6 according to the span of the bridge.

8. [redacted] if the new method for calculating construction safety is applied, all the parts of a particular construction have the same capacity and the same safety. Furthermore, the new method results in saving of materials without sacrificing the safety of the construction. Relatively more material is saved in constructions which have a greater dead load. Finally, from a military viewpoint, the ultimate capacity of a construction can easily be determined in an emergency.